National Institute of Environmental Health Sciences

The societal costs and benefits of commuter bicycling: Simulating the effects of specific policies using system dynamics modeling

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Abstract:

Background: Shifting to active modes of transport in the trip to work can achieve substantial co-benefits for health, social equity, and climate change mitigation. Previous integrated modeling of transport scenarios has assumed active transport mode share and has been unable to incorporate acknowledged system feedbacks. Objectives: We compared the effects of policies to increase bicycle commuting in a car-dominated city and explored the role of participatory modeling to support transport planning in the face of complexity. Methods: We used system dynamics modeling (SDM) to compare realistic policies, incorporating feedback effects, nonlinear relationships, and time delays between variables. We developed a system dynamics model of commuter bicycling through interviews and workshops with policy, community, and academic stakeholders. We incorporated best available evidence to simulate five policy scenarios over the next 40 years in Auckland, New Zealand. Injury, physical activity, fuel costs, air pollution, and carbon emissions outcomes were simulated. Results: Using the simulation model, we demonstrated the kinds of policies that would likely be needed to change a historical pattern of decline in cycling into a pattern of growth that would meet policy goals. Our model projections suggest that transforming urban roads over the next 40 years, using best practice physical separation on main roads and bicycle-friendly speed reduction on local streets, would yield benefits 10-25 times greater than costs. Conclusions: To our knowledge, this is the first integrated simulation model of future specific bicycling policies. Our projections provide practical evidence that may be used by health and transport policy makers to optimize the benefits of transport bicycling while minimizing negative consequences in a cost-effective manner. The modeling process enhanced understanding by a range of stakeholders of cycling as a complex system. Participatory SDM can be a helpful method for integrating health and environmental outcomes in transport and urban planning.

Source: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3984216

Resource Description

Exposure :

weather or climate related pathway by which climate change affects health

Air Pollution

Air Pollution: Particulate Matter

Geographic Feature:

resource focuses on specific type of geography

Urban

Geographic Location: ☑

resource focuses on specific location

Non-United States

Non-United States: Australasia

Health Co-Benefit/Co–Harm (Adaption/Mitigation): ☑

specification of beneficial or harmful impacts to health resulting from efforts to reduce or cope with greenhouse gases

A focus of content

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Cancer, Cardiovascular Effect, Injury, Morbidity/Mortality, Respiratory Effect, Other Health Impact

Respiratory Effect: Chronic Obstructive Pulmonary Disease

Other Health Impact: Hospitilizations

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Mitigation

Model/Methodology: ☑

type of model used or methodology development is a focus of resource

Cost/Economic, Exposure Change Prediction, Other Projection Model/Methodology

Other Projection Model/Methodology: Bicycle mode share; GHG emissions

Resource Type: ☑

format or standard characteristic of resource

Policy/Opinion, Research Article

Timescale: ☑

time period studied

Long-Term (>50 years)

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content